

WHAT IS CLAIMED IS:

1. A bias current generating circuit comprising:

a bandgap reference circuit connected to a high power supply voltage terminal for receiving a high power supply voltage and a low power supply voltage terminal for receiving a low power supply voltage, and having a first output terminal for outputting a first voltage which is constant regardless of a temperature, and a second output terminal for outputting a second voltage which changes in accordance with a temperature;

a first low-potential-side constant-current source circuit which includes a first resistor connected between said low power supply voltage terminal and a first terminal, and a first current path connected between said first terminal and a first current supply terminal, receives the second voltage as a reference potential, and outputs a first electric current dependent on a temperature and corresponding to said first resistor from said first current supply terminal;

a second low-potential-side constant-current source circuit which includes a second resistor connected between said low power supply voltage terminal and a second terminal, and a second current path connected between said second terminal and a second current supply terminal, receives the first voltage as a reference potential, and outputs a second electric current independent of a temperature and corresponding to said second resistor from said second current supply terminal;

a third resistor having one end connected to said high power supply voltage terminal;

a third low-potential-side constant-current source circuit which is connected between the other end of said third resistor and said low power supply voltage terminal, receives the first voltage as a reference potential, and supplies a temperature-independent third

electric current to said third resistor;

a high-potential-side constant-current source circuit which includes a fourth resistor connected between said high power supply voltage terminal and a third terminal, and a third current path connected between said third terminal and a third current supply terminal, receives a third voltage at the other end of said third resistor as a reference potential, and outputs a fourth electric current independent of a temperature and corresponding to said fourth resistor from said third current supply terminal; and

a current mirror circuit which is connected to said high power supply voltage terminal to receive the high power supply voltage, and generates a bias current in accordance with an electric current supplied from a reference current terminal,

wherein said first, second, and third current supply terminals are connected to said reference current terminal.

2. A circuit according to claim 1, wherein

said first low-potential-side constant-current source circuit comprises:

a first operational amplifier having a non-inverting input terminal connected to said second output terminal, and an inverting input terminal connected to said first terminal; and

a first NMOS transistor having a drain connected to said first current supply terminal, a gate connected to an output terminal of said first operational amplifier, and a source connected to said first terminal,

said second low-potential-side constant-current source circuit comprises:

a second operational amplifier having a non-inverting input terminal connected to said first output terminal, and an inverting input terminal connected to said second terminal; and

a second NMOS transistor having a drain connected to said second current supply terminal, a gate connected to an output terminal of said second operational amplifier, and a source connected to said second terminal, and

said high-potential-side constant-current source circuit comprises:

a third operational amplifier having a non-inverting input terminal connected to said third terminal, and an inverting input terminal connected to the other end of said third resistor; and

a first PMOS transistor having a source connected to said third terminal, a gate connected to an output terminal of said third operational amplifier, and a drain connected to said third current supply terminal.

3. A circuit according to claim 2, wherein

said third low-potential-side constant-current source circuit comprises:

a fourth operational amplifier having a non-inverting input terminal connected to said first output terminal;

a third NMOS transistor having a drain connected to the other end of said third resistor, and a gate connected to an output terminal of said fourth operational amplifier; and

a fifth resistor having one end connected to an inverting input terminal of said fourth operational amplifier and a source of said third NMOS transistor, and the other end connected to said low power supply voltage terminal, and

said current mirror circuit comprises:

a second PMOS transistor having a source connected to said high power supply voltage terminal, and a gate and drain connected to said reference current terminal; and

a third PMOS transistor having a source connected

to said high power supply voltage terminal, and a gate connected to said reference current terminal, said third PMOS transistor outputting the bias current from the source thereof.

4. A circuit according to claim 2, wherein each of said first, second, and fourth resistors is one of a fixed resistor, variable resistor, and electronic volume IC.

5. A circuit according to claim 1, wherein
said first low-potential-side constant-current source circuit comprises:

a first operational amplifier having a non-inverting input terminal connected to said second output terminal, and an inverting input terminal connected to said first terminal; and

a first NPN bipolar transistor having a collector connected to said first current supply terminal, a base connected to an output terminal of said first operational amplifier, and an emitter connected to said first terminal,

said second low-potential-side constant-current source circuit comprises:

a second operational amplifier having a non-inverting input terminal connected to said first output terminal, and an inverting input terminal connected to said second terminal; and

a second NPN bipolar transistor having a collector connected to said second current supply terminal, a base connected to an output terminal of said second operational amplifier, and an emitter connected to said second terminal, and

said high-potential-side constant-current source circuit comprises:

a third operational amplifier having a non-inverting input terminal connected to said third terminal, and an inverting input terminal connected to

the other end of said third resistor; and

a first PNP bipolar transistor having an emitter connected to said third terminal, a base connected to an output terminal of said third operational amplifier, and a collector connected to said third current supply terminal.

6. A circuit according to claim 5, wherein

said third low-potential-side constant-current source circuit comprises:

a fourth operational amplifier having a non-inverting input terminal connected to said first output terminal;

a third NPN bipolar transistor having a collector connected to the other end of said third resistor, and a base connected to an output terminal of said fourth operational amplifier; and

a fifth resistor having one end connected to an inverting input terminal of said fourth operational amplifier and an emitter of said third NPN bipolar transistor, and the other end connected to said low power supply voltage terminal, and

said current mirror circuit comprises:

a second PNP bipolar transistor having a source connected to said high power supply voltage terminal, and a gate and drain connected to said reference current terminal; and

a third PNP bipolar transistor having a source connected to said high power supply voltage terminal, and a gate connected to said reference current terminal, said third PNP bipolar outputting the bias current from the source thereof.

7. A circuit according to claim 5, wherein each of said first, second, and fourth resistors is one of a fixed resistor, variable resistor, and electronic volume IC.

8. A circuit according to claim 1, wherein

said third low-potential-side constant-current source circuit comprises:

a fourth operational amplifier having a non-inverting input terminal connected to said first output terminal;

a third NMOS transistor having a drain connected to the other end of said third resistor, and a gate connected to an output terminal of said fourth operational amplifier; and

a fifth resistor having one end connected to an inverting input terminal of said fourth operational amplifier and a source of said third NMOS transistor, and the other end connected to said low power supply voltage terminal, and

said current mirror circuit comprises:

a second PMOS transistor having a source connected to said high power supply voltage terminal, and a gate and drain connected to said reference current terminal; and

a third PMOS transistor having a source connected to said high power supply voltage terminal, and a gate connected to said reference current terminal, said third PMOS transistor outputting the bias current from the source thereof.

9. A circuit according to claim 8, wherein each of said first, second, and fourth resistors is one of a fixed resistor, variable resistor, and electronic volume IC.

10. A circuit according to claim 1, wherein

said third low-potential-side constant-current source circuit comprises:

a fourth operational amplifier having a non-inverting input terminal connected to said first output terminal;

a third NPN bipolar transistor having a collector connected to the other end of said third resistor, and a

base connected to an output terminal of said fourth operational amplifier; and

a fifth resistor having one end connected to an inverting input terminal of said fourth operational amplifier and an emitter of said third NPN bipolar transistor, and the other end connected to said low power supply voltage terminal, and

said current mirror circuit comprises:

a second PNP bipolar transistor having a source connected to said high power supply voltage terminal, and a gate and drain connected to said reference current terminal; and

a third PNP bipolar transistor having a source connected to said high power supply voltage terminal, and a gate connected to said reference current terminal, said third PNP bipolar outputting the bias current from the source thereof.

11. A circuit according to claim 10, wherein each of said first, second, and fourth resistors is one of a fixed resistor, variable resistor, and electronic volume IC.

12. A circuit according to claim 1, wherein each of said first, second, and fourth resistors is one of a fixed resistor, variable resistor, and electronic volume IC.

13. A laser diode driving circuit comprising:

a sixth resistor having one end connected to said high power supply voltage terminal;

a fourth NPN bipolar transistor having a collector connected to the other end of said sixth resistor, and a base which receives one differential input signal;

a seventh resistor having one end connected to said high power supply voltage terminal;

a fifth NPN bipolar transistor having a collector connected to the other end of said seventh resistor, and a base which receives the other differential input

signal;

a sixth NPN bipolar transistor having a collector connected to emitters of said fourth and fifth NPN bipolar transistors, a base connected to a current input terminal, and an emitter which is grounded either directly or via an eighth resistor;

a differential output unit which performs differential amplification by receiving the differential output signals, and generates a driving current signal for driving a laser diode from the collector of at least one of said fourth and fifth NPN bipolar transistors;

said bias current generating circuit cited in claim 1; and

a driving current controller which receives the bias current generated by said bias current generating circuit, amplifies the received bias current, and supplies the amplified bias current to the current input terminal of said differential output unit.

14. An optical communication transmitter comprising:

said laser diode driving circuit cited in claim 13;

and

a laser diode which receives the driving current signal generated by said laser diode driving circuit.

15. A laser diode driving circuit comprising:

a sixth resistor having one end connected to said high power supply voltage terminal;

a fourth NPN bipolar transistor having a collector connected to the other end of said sixth resistor, and a base which receives one differential input signal;

a seventh resistor having one end connected to said high power supply voltage terminal;

a fifth NPN bipolar transistor having a collector connected to the other end of said seventh resistor, and a base which receives the other differential input signal;

a sixth NPN bipolar transistor having a collector

connected to emitters of said fourth and fifth NPN bipolar transistors, a base connected to a current input terminal, and an emitter which is grounded either directly or via an eighth resistor;

a differential output unit which performs differential amplification by receiving the differential output signals, and generates a driving current signal for driving a laser diode from the collector of at least one of said fourth and fifth NPN bipolar transistors;

said bias current generating circuit cited in claim 2; and

a driving current controller which receives the bias current generated by said bias current generating circuit, amplifies the received bias current, and supplies the amplified bias current to the current input terminal of said differential output unit.

16. An optical communication transmitter comprising:

said laser diode driving circuit cited in claim 15; and

a laser diode which receives the driving current signal generated by said laser diode driving circuit.